

# NAVAL POSTGRADUATE SCHOOL

## Monterey, California



## THESIS

**THE REGIONAL JET, CANCER OR CURE?  
A TREND ANALYSIS DETAILING THE EFFECTS  
OF THE REGIONAL JET ON THE QUALITY OF AIR  
SERVICE OFFERED AT SMALL COMMUNITY  
AIRPORTS**

by

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June 2000

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OFFERED AT SMALL COMMUNITY AIRPORTS**

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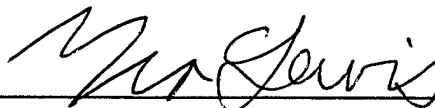
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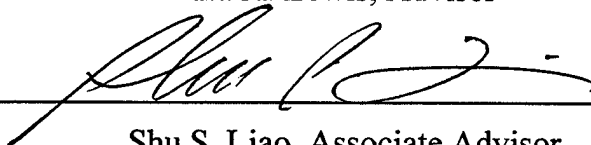


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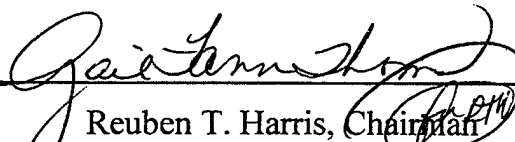
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## **ABSTRACT**

There are 201 communities across the continental United States with 50,000 or less enplanements and commercial air service being provided exclusively by turboprop or propeller driven aircraft. The character and quality of air service to these communities has been consistently changing since the Airline Deregulation Act of 1978. The insurgence of the Regional Jet into the regional aviation marketplace has been the recent instigator that has changed the quality determinants of regional air service. This study determines the influence of these factors in the determination of an airport's demand for air service, to predict which of the 201 communities would most likely lose its air service. The resulting findings were that 79 of the 201 small community airports were identified as those who had a possibility of losing air service and 34 of those 79 were identified as airports most likely to lose air service in the next decade.



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## I. INTRODUCTION

The domestic commuter airline industry has undergone a revolution in the past few years with the advent of the modern regional jet. After a slow-paced introduction by a lone United States carrier in 1993, the regional jet *frenzy* has literally 'taken off.' Regional jets and modern turboprop aircraft have allowed the regional industry to achieve record growth. Such growth in passenger traffic will likely increase passenger demand for regional jet service and possibly compound the problems already faced by some small communities. (Office of the Assistant Secretary for Aviation and International Affairs [OASAIA], 1998, pp. 1, 22)

This thesis reviews the impact of the Regional Jet on the quality of commercial air service offered by small community airports.

### A. BACKGROUND

Beneficial changes and developments in governing regulations and aircraft design have brought the regional airline industry full circle. These changes have seen the industry develop from one that thrived off of service to local small markets, to one that with significant economic growth and the utilization of more sophisticated jet aircraft, has possibly outgrown these smaller markets. If the regional airlines are to effectively serve these small markets again, there must be additional, positive changes in the industry's governing regulations and aircraft design.

During the 1970's the regional airline market consisted primarily of local commuter airlines that provided connections between local small cities and larger metropolitan areas. The aircraft utilized for this mission held between eight and fifteen seats and in most cases, were powered by reciprocating, piston engines. Deregulation of

the industry enabled the large national and major airlines to end the service they had provided to the small communities. These larger airlines then concentrated on the higher yield routes between the larger metropolitan areas, which provided the foundation for the current “hub and spoke” route system. Accordingly, small commuter airlines acquired larger turboprop aircraft to replace the aircraft once used by the major airlines on these low yield routes.

During the 1980’s, the post-deregulation years, commuter airlines experienced significant growth, primarily through airline consolidation and the practice of “code sharing” with the larger major airlines. Consequently, during the 1990’s the former small commuter airlines, now consolidated, formed large regional operators. In an effort to capture a share of the rapidly growing market, regional airlines began to adhere to customer demands for jet service. This effort was evidenced by the fact that during the late 1990’s, all of the major regional airlines were flying Regional Jets, most with the expressed intent of using them to completely dislodge all the turboprop aircraft in their inventories. Unfortunately, the progression of the regional airline industry in aircraft design as seen in the replacement of turboprop aircraft with Regional Jets has proven to add to the air service woes of many small communities.

In terms of legislation, following deregulation in 1978, the United States government subsidized unprofitable routes that would have not been served by scheduled airlines. This was a directed effort to improve the quality of air service offered at small airports since these unprofitable routes were very often those which connected to small communities. The Essential Air Service (EAS) program allowed airlines the chance to



remain profitable on these low yield routes. During the 1990's, funding for the EAS program was significantly cut, which reduced the opportunities available for regional airlines to profitably serve these low yield routes to smaller communities. However, later in that decade EAS spending had rebounded and other legislation had been introduced in the attempt to solve the poor air service woes of small communities. Conversely, many industry experts questioned the increased governmental funding due to the ambiguous results of such programs in providing quality air service to small communities, especially since these increases occurred during a period of significantly decreased government spending.

## **B. OBJECTIVES**

The objectives of this thesis are: 1) to determine the impact of the Regional Jet on the quality of commercial air service rendered by small community airports, and 2) to draw a conclusion as to whether governmental support programs should be enacted and/or continued to counteract any negative impacts that are discovered in the initial objective.

## **C. RESEARCH QUESTIONS**

The following primary research questions will be examined:

- What are the impacts on the quality of commercial air service offered at small community airports, as a result of the regional airlines' overwhelming acceptance of the Regional Jet?
- To what extent should the United States government fund regional airlines to service small community airports?

The following secondary research questions will be examined:

- What effect did the Airline Deregulation Act of 1978 have on commercial air service to small community airports?
- What parallels may be drawn between the effects of the Airline Deregulation Act of 1978 and the effects of the Regional Jet's insurgence in the regional airline market as they affect service to small community airports?

#### **D. SCOPE, LIMITATIONS AND ASSUMPTIONS**

##### **1. Scope**

Existing data on the Regional Jet (RJ), small community airports and governmental legislation effecting the two was examined for possible connections related to the quality of service available at these small airports. The quality of air service, for this study, was identified as the frequency of flights being offered from an airport, the size and type of aircraft utilized for air service and the number of commercial passenger airlines serving an airport. This study focused on the effects or anticipated effects of this data as it applies to the domestic, regional airline marketplace. Only contemporary Regional Jets that were being produced and utilized between 1989 and 1999 were discussed and examined. Additional aircraft types were discussed only if there was to be comparisons made between them and the Regional Jets and/or if these aircraft serviced the small community airports. The air service trends from 1978 until the present relating to small community airports and the regional aviation marketplace were discussed and

examined. Larger airports, larger commercial jet aircraft and additional aviation focused legislation not related to commercial air service offered at small community airports or the Regional Jet was not included in this study.

The scope of this study was refined to facilitate a specific focus on the effects of the Regional Jet on the quality of service rendered to small airports in the continental United States and the supporting related legislation. Areas outside of the stated region of focus were excluded due to the different environmental factors that determined their levels of commercial air service.

## **2. Limitations**

The following related issues within the regional airline marketplace were developing concurrent to this study, therefore preventing the inclusion of certain pertinent data:

- Congressional discussion over legislation regarding the Regional Jet, possible increases in EAS funding, and possible increases funding for small community airports, all of which would directly affect industry trends, was examined. These legislative issues were discussed to familiarize the reader with the direction of the regional airline industry, but were not included in the data that was examined.
- Due to competition, regional airlines that were operating Regional Jets would not divulge specific load capacity data. The initial intent was to use this data in comparison to the load factors of turboprop aircraft being operated in similar markets, on similar routes. This comparison data would have been utilized to justify the "turboprop avoidance factor."
- The latest enplanement trend data for all the small community airports was not available. Therefore, a sample of known airports was utilized to conduct an

analysis that targeted an airport's enplanement figures. The utilization of only a sample, vice all the members fitting these criteria, narrowed the focus of the analysis and possibly omitted airports that could be in jeopardy of losing air service.

### **3. Assumptions**

It is assumed that the reader has a minimal level of understanding concerning the basic market economic principles of supply and demand and general concepts concerning commercial aviation. This is necessary as these concepts are briefly reviewed in this thesis.

## **E. LITERATURE REVIEW AND METHODOLOGY**

There are numerous pieces of literature relating the state of the quality of commercial air service offered by small community airports and their probable future. Additionally, there are numerous pieces of literature hailing the Regional Jet's insurgence into the commercial aviation marketplace, crowning it the king of the regional airline's aircraft inventory. However, there are very few pieces of literature relating the two, or quantifying the effects of the Regional Jet's presence on the future of small community airports. This thesis will review literature relative to these aircraft and airport types in order to identify a quantifiable correlation between the two.

The methodology utilized to quantify the correlation between Regional Jet utilization and the future of the small community airport utilized methodologies from three models. Fisher and Hulet (1982) developed and demonstrated a quantitative method to determine the minimum passenger enplanement totals required to justify air

service at local small community airports. The model focused on the primary aspects of: 1) the distance of the community from a major hub, and 2) the quality of service offered by the local airport and the closest alternate airport (Fisher & Hulet, 1982, p. 21). Although the focus was on the spacial considerations as a determinant of an airport's quality of air service, this model, however, omitted a currently relevant factor, the "turboprop avoidance factor" as a determinant in the quality of service calculations; a factor that was not diagnosed during a period concurrent to the Fisher & Hulet model.

Vowles (1997) developed a model that predicted the loss of air service to small communities based on specific variables whose scope focused on certain operational, economical, geographic and social issues. Vowles' model utilized a logistic regression to determine the probability of an airport's loss of air service. However, Vowles did not capture the spatial consideration, the distance between a small community airport and a larger hub airport offering jet service, in his probability determination. Again, Fisher and Hulet (1982) exhibited that an small airport's relative distance to a hub offering a higher quality of air service, is an important determinant relative to the future of air service at that small community airport.

Brewer and Thorson (1978) developed a model that determined a city's demand for commuter airline service. The model utilized a nonlinear regression analysis to identify that the most viable determinants of demand for commuter air service were the respective community's population and measurements of isolation of that community from the certified air carrier transportation system (Brewer & Thorson, 1978, p. 187). The model utilized the average daily enplanement figure of each respective community as

a dependant variable to identify the level of ridership needed by a community to support commuter air service.

The methodology utilized in this thesis captures certain spatial considerations as identified by the Fisher and Hulet model and certain operational considerations as identified by Vowles' econometric model, while incorporating the contemporary regional airline market factors of turboprop avoidance and Regional Jet stimulation. This thesis categorizes certain small community airports into two groups, those that are likely to retain their air service and those that are like to lose their air service. Through variance analysis, this thesis' identifies the defining characteristics of each of these two groups and then determines the level of impact of each of the identified operational and spatial determinants, on the small community airports' level of demand for air service. The thesis model utilized the small community airport's average daily enplanement figures, as identified by Brewer and Thorson, as an expression of air service demand.

## **F. DEFINITIONS AND ABBREVIATIONS**

- *Code Sharing*: The partnering of a smaller regional or commuter airline with a larger major airline through the sharing of reservation coding, seating, scheduling and often identity. (Davies & Quastler, 1995, pp. 134-164)
- *Commuter Airline*: An air carrier that operates aircraft with 30 seats or less and a maximum payload capacity of 7,500 pounds or less and performs at least 5 round trips per week between 2 or more points and publishes a flight schedule. (Reynolds-Feighan, 1999, pp. 559-560)
- *General Aviation Airports*: Airports with less than 2,500 annual enplanements. (Reynolds-Feighan, 1999, pp. 559)

- *Hub*: An airport in the national-airways system through which air carriers develop a system of routes of operation between it and other airports in the system. (Reynolds-Feighan, 1999, pp. 558)
- *Primary Airport*: An airport that is receiving commercial air service with at least 10,000 annual passenger enplanements. (AAAE, 1999, pp. 21-22)
- *Regional Airline*: An air carrier holding a Certificate of Public Convenience and Necessity that operates aircraft with 30 seats or more; or a maximum payload capacity of more than 18,000 pounds, with annual operating revenues no greater than \$100 million. (Reynolds-Feighan, 1999, pp. 575)
- *Regional Jet*: A jet powered and propelled aircraft seating between 30 to 70 passengers, having operational ranges from 300 to 1500 nautical miles at maximum speeds of 400 to 500 miles per hour. Abbreviated as RJ. (DOT, 1998, pp. 6-11)
- *Small Community*: Communities having a maximum metropolitan area population of 300,000. (General Accounting Office [GAO], 1998, pp. 3)
- *Small Hub Airport*: An airport with between 0.05-0.0249 percent of the annual total of domestic enplanements and a minimum of 10,001 enplanements. (Reynolds-Feighan, 1999, pp. 559)
- *Turboprop*: A jet powered, propeller driven aircraft seating between fifteen to 75 passengers, having operational ranges from 50 to 700 nautical miles at maximum speeds of 200 to 420 miles per hour. (Davies & Quastler, 1995, pp. 47-48, 164, 150, 447-448)
- *Turboprop Avoidance Factor*: A measurement of the extent to which a potential airline passenger will choose jet service over turboprop/propeller service. (Prall, 1997, pp. 26)
- *Very Small Community*: A community with a population of less than 25,000. (Reynolds-Feighan, 1999, pp. 564)

## **G. ORGANIZATION OF STUDY**

The first chapter of this thesis gives an introduction to the concepts and methodology used to identify the issues relating to the regional airline markets' utilization of Regional Jets and their effects on the air service offered to small community airports. It identifies the research questions that the thesis is to address and defines the manner in which the thesis will address them.

The second chapter encompasses the literature that frames the thesis' conclusion and recommendations. It contains the findings and conclusions of consultants and other aviation experts regarding the market's reaction to the insurgence of the Regional Jet and explains the models that were utilized to form the basis for the thesis' methodology. Focusing on specific issues spurred by the Regional Jet as it relates to the small community airport, it narrows the broad view presented in Chapter I.

Within the third chapter lies the thesis' methodology. The models and procedures utilized to formulate the thesis' foundational ideals are explained and their authors are credited. The data that was collected regarding the effects of Regional Jets on small community airports is presented in Chapter IV. Included are airport performance figures pertinent to problem identification and possible resolution. Chapter IV concludes with a relevant analysis of the data previously presented in the chapter. Finally, Chapter V presents the thesis' conclusions and recommendations as well as areas that require further research.



## **II. LITERATURE REVIEW AND BACKGROUND**

### **A. THE AIRLINE DEREGULATION ACT OF 1978 AND THE SMALL COMMUNITY AIRPORT**

#### **1. Background of the Airline Deregulation Act of 1978**

Prior to 1978, the government, through the efforts of the Civil Aeronautics Board (CAB), regulated the commercial airline marketplace. The CAB's underlying belief was that air travelers were unwilling to pay the full cost for the air services found on the short-haul routes to small communities, but were willing to pay slightly higher than market costs on long-haul routes between large communities. If full cost were allocated to the passengers, it was believed that they would seek alternate means of transportation. With this in mind, the CAB consciously mandated that fares on these short-haul air routes be lower than market price and higher than market fares on long-haul routes. Congress decided to deregulate the airline industry due to its concern that the CAB's practices created market inefficiencies and stunted possible industry growth. Congress' intent for deregulation was that it would: a) lower the airfares on the long-haul routes found at large community airports and slightly increase the airfares on short-haul routes found at small community airports, b) increase the number of airlines operating at most airports, thereby increasing competition, and c) increase the use of turboprop aircraft, vice jets, on short-haul routes to small communities that were not able to support jet service. (General Accounting Office [GAO], 1996, pp. 2)

## **2. A Before and After Comparison of the Airline Deregulation Act**

The passage of the Airline Deregulation Act (ADA) of 1978 placed control of the airline industry into the hands of the airlines, vice the CAB. Before deregulation, the CAB dictated the number of airlines and set airfares on air routes. Immediately following deregulation the market, which operated to obtain profit, dictated competition and determined airfares. Before deregulation, the CAB had subsidized air carriers if they were flying unprofitable routes, because it focused not on profits, but on providing communities access to the national transportation system. Immediately following deregulation, major air carriers pulled out of the small communities and sought to operate solely on the more profitable routes between larger communities (Vowles, 1997, p. 823).

## **B. ESSENTIAL AIR SERVICE AND THE SMALL COMMUNITY AIRPORT**

### **1. Background of the Essential Air Service Program**

The Essential Air Service (EAS) program sprouted from concern that following the ADA of 1978, small communities would lose air service once the national and major airlines, free from regulation to serve these less profitable routes, left their markets. Congress addressed this concern with the addition of section 419 to the Federal Aviation Act, which established the EAS program, as a method to ensure small communities had connection to the national transportation system via air service. (Office of Aviation Analysis [OAA], 1997, p. 1)

An ironic holdover of the ADA of 1978 was the EAS program, which regulated air service at each community that received essential air service. The program established air carrier eligibility guidelines that: a) required it to offer a minimum number of round trips and a specified amount of available seats to a predetermined hub, b) to utilize a specified aircraft type with a set minimum seating capacity, and c) to minimize the number of intermediate stops enroute to the predetermined hub. An air carrier that offered these services to a community was stated to be servicing, in EAS program terms, a community with essential and "basic" air service. Communities which were receiving air service on October 24, 1978, and those not receiving air service but that were listed on an air carrier's scheduled service certificate, were eligible for EAS program funding (GAO, 2000, p. 6). The Department of Transportation (DOT) supported the EAS program to the extent that it would subsidize an air carrier, if necessary, in the service of a community. Most communities, however, did not require that an airline receive a subsidy for it to render air service. (OAA, 1997, p. 1)

Initially, Congress gave authorization for the EAS program to last for the ten years following the 1978 ADA, until October 23, 1988. With continued strong interest in the state of small community air service, Congress enacted the Airport and Airway Safety and Capacity Expansion Act of 1987, which extended the EAS program for an additional ten years, until 1998. Also in 1987, Public Law 100-223 was enacted which included a provision for any EAS eligible community to receive "enhanced" essential air service if it would either share in the subsidies offered to an air carrier to provide the improved service or accept the risk of losing basic service if enplanement levels did not meet those

required to receive subsidy funding. In 1996, Congress began funding the EAS program via the Rural Air Service Survival Act, which removed the September 30, 1998 program conclusion date. Throughout its tenure, funding levels for the EAS program have fluctuated, causing some communities to lose air service. (OAA, 1997)

Currently, the EAS program, though modified from its beginnings in 1978, still survives in order to ensure basic levels of air service are offered at small community airports. The program offers subsidy benefits and the requirement that an air carrier submit a ninety-day notification prior to its discontinuance of air service, to eligible community airports. Present day eligibility requirements include community location greater than 70 highway miles from the nearest medium-hub or large-hub community airport and a per passenger subsidy limitation of 200 dollars. If the community is located greater than 210 miles from the nearest medium-hub or large-hub community airport, the per passenger subsidy limitation is waived. The DOT subsidized 68 communities in the continental United States, through the EAS program, in 1999. (GAO, 2000)

## **2. Differing Views Regarding Program Effectiveness**

There have been mixed views regarding the effectiveness of the EAS program. Reynolds-Feighan (1999) suggested that the effects of the EAS program are positive, beginning with the fact that it fostered growth in the regional airline marketplace by encouraging commuter airlines to fill the niches left by major airlines which vacated small, unprofitable markets following the passing of the ADA of 1978. This was evidenced with the fact that commuter airlines that handled only ten percent of the total

small community airport's enplanements in 1977, grew to handle 51 percent of these enplanements by 1988. Also aiding in EAS growth and improving the position of the small community airports, is the fact that, as stated by Reynolds-Feighan, the EAS program has apparently shifted its focus from the "small community", to the "very small community" (see definitions on p. 9). This shift is apparent with the fall of the average population of the communities receiving EAS subsidies to a 1999 figure of 24,306. (Reynolds-Feighan, 1999)

The basis of opposition to the EAS program has its foundation in that regulation generally does not promote an atmosphere of market efficiency. Vowles (1997) highlighted the fact that in order for an airline to be profitable, it must be allowed to match the service it renders to the demand offered in a particular market. The very small community markets that are the majority of the EAS program stakeholders often only have enough ridership to support small turboprop aircraft (Vowles, 1997, p. 828). The traveling public sentiment against small turboprop aircraft has grown increasingly more intense following 1995 due to the concern raised by several high-profile, turboprop accidents (OASALA, 1998, P.5). This sentiment has been named the "turboprop avoidance factor." As a result of this phenomenon, passengers are often unwilling to fly turboprop aircraft, an experience that usually escalates to a phobia when it comes to flying smaller turboprop aircraft. Therefore, as Boyd (1998) suggested, the government could be paying airlines to fly aircraft that the majority of passengers do not want to fly. The result, subsidized empty seats. As reported in the GAO's (2000) report on the EAS program, the facts show that out of the 68 communities in the continental United States

that receive subsidized air service, 30 experienced decreased levels of ridership, with an average loss of 27 percent. These facts appear to validate Boyd's concerns.

Boyd (1997) suggested that the Department of Transportation should be reminded that the purpose of the EAS program was to provide basic service to eligible small communities in order for them to have continued access to the national transportation system. Reynolds-Feighan (1999) reported that the average distance between small EAS communities and their nearest large or medium hub community airports was 171 miles for subsidized communities and 121 miles from the unsubsidized EAS communities. Travel times between these EAS communities and their closest large or medium hub community airports would vary in respect to these distances, road quality and traffic conditions (Reynolds-Feighan, 1999). However, Morrow (2000) stated that in an informal survey, Delta Air Lines recently found that its passengers dislike flying turboprops so much that most are willing to drive two to five hours to avoid flying on them. The distances between the subsidized and the unsubsidized communities and their closest hub community airports, lie well within the driving distances mentioned in the Delta Airline survey. The passenger losses experienced by 44 percent of the subsidized communities could be as a result of what Vowles called the "gravity effect." Vowles explained that the gravity effect is the leakage of passengers from a smaller airport to one that offers superior air service.

As explained by Boyd (1998), since a significant number of EAS communities are experiencing reduced traffic due to the turboprop avoidance factor and the gravity effect, it is suggested that the EAS program has been, especially recently, ineffective. Boyd's

(1997) basis for this conclusion lies in the fact that the traveling public appears to have connected themselves, not the EAS program, to the national transportation system via highways that lead to airports that offer jet service. In essence, if the market forces were allowed to operate vice the regulations of the EAS program, Boyd (1998) predicts that many EAS communities, possibly those that experienced significant decreased ridership from 1995 to 1998, would likely lose all air service. However, all would not be lose, for these communities seem to already have connected themselves to the national transportation system via respective local highways, therefore, fulfilling the purpose of the EAS program (Boyd, 1997).

## **C. POST-DEREGULATION GROWTH**

### **1. Policy Changes**

Davies and Quastler (1995) discussed several issues resulting from deregulation that had a great impact upon the commuter aviation marketplace. Probably the most influential change described was a change in FAA regulations that allowed of commuter aircraft to increase in size from a maximum of 30 to 55 seats as well as an increase in payload from 7,500 pounds to 18,000 pounds. This particular policy change, as Davies and Quastler point out, allowed many larger aircraft types to be utilized to serve the small community airports and thus facilitate the industry's ability to carry larger passenger loads which increased its growth potential.

## **2. Reasons for Growth**

Post-deregulation growth was experienced by commuter airlines in markets that connect small communities to large metropolitan areas. This growth was significantly quickened by the 1979 fuel crisis, which deterred passengers from using their cars to drive short distances due to higher gasoline prices. Also, the fuel crisis created an atmosphere that made the utilization of large aircraft in the service of short routes, highly uneconomical. This fact caused major airlines to pull out of important intercity routes such as New York to Philadelphia, in order to reduce and further avoid the higher operating costs that accompanied such routes. These abandoned routes were then picked up by commuter airlines. The combination of these factors increased the importance of the short-haul, high-density markets. In just three years following deregulation, commuter airline enplanements increased by 34 percent, a fact that is exhibited in Table 2.1. (Davies & Quastler, 1995, pp. 115-122)

## **3. Results of Growth**

Rapid growth in traffic and route networks following passage of the ADA quickly lead to a shortage of commuter aircraft shortage soon ensued. Manufacturers struggled to support demand and were forced to develop new aircraft to fit the needs of the commuter airline marketplace (Davies & Quastler, 1995, pp. 115-122). Immediately following the ADA of 1978, airframe manufacturers, in an effort to keep up with commuter airline demand, produced larger numbers of newly designed, turboprop aircraft. As the number of aircraft produced increased, the number of aircraft being utilized for passenger service



increased. In 1979 alone, the aircraft utilized by regional and commuter airlines increased by 21 percent (Jewell, 1999, p. 2). This boom in aircraft manufacturing was initially focused on aircraft seating a maximum of 19 passengers. The focused production of smaller sized turboprop aircraft was a direct result of the CAB's and the Federal Aviation Administration's (FAA) commuter airline aircraft limitations, which limited an aircraft's payload and required a flight attendant on all aircraft seating more than 19 passengers (Davies & Quastler, 1995). In their analysis of the industry, Bernstein and Abbey (1997) identified that during the early 1980, the regional airline marketplace's major demand was focused on the 30-plus passenger turboprop aircraft. Companies such as deHavilland, Aerospatiale, British Aerospace, Fokker, Saab and Embraer flooded the market with aircraft that fit its need (Bernstein & Abbey, 1997).

During the 1990s, the regional airline marketplace has demanded fuel efficient jet aircraft that seat between 30 and 90 passengers. As they have done in the previous decades, aircraft manufacturers such as Aero International Regional (AIR), Bombardier (formerly deHavilland), British Aerospace (partners with Aerospatiale with the AIR corporation), Embraer, and Fairchild-Dornier, have answered the industry's demand with aircraft meeting its requirements. According to Vowles (1997), the increased demand for jet aircraft is based on technological advancement and customer satisfaction. The ideals of technological advancement and customer satisfaction have their foundation in basic market economic theory, with technological advancement being a determinant of supply and customer satisfaction being a determinant of demand. Therefore, the change in focus

of the regional airline marketplace to Regional Jets represents a market that is being fashioned by basic economic determinants. (Bernstein & Abbey, 1997)

#### **4. Decrease in the Quality of Air Service**

Not all communities have benefited from the commercial aviation industry's market growth resulting from deregulation (GAO, 1998, p. 1). A 1998 GAO study concluded that small community airports, especially those located in the East and upper Midwest, have experienced poorer air service since deregulation. Determining an airport's air service quality was found to be a decision based on subjective weighting of the importance of the number and frequency of flights to passenger desired destinations and the type of aircraft used (GAO, 1996, p. 3). The East's and the upper Midwest's small community airports had experienced a decline in the quantity and quality of air service witnessed by sharp declines in the number of available nonstop flights, frequency, and in the amount of jet service relative to turboprop service (GAO, 1998, p. 3). However, this decrease in jet service to small community airports was not just experienced in the previously mentioned regions, but rather throughout the entire domestic commercial aviation marketplace. In a 1996 GAO study regarding the effects of deregulation, it was reported that the number of jet departures from small community airports had fallen 27 percent during the post-deregulation period of 1978 to 1995. The result of this decline was an increase in turboprop departures from small community airports (GAO, 1996, p. 47). The reason for the decrease in jet service was found to be largely because established airlines, following deregulation, had reduced jet service from

these smaller airports and deployed turboprops to link these communities to the major airlines' hubs (GAO, 1998, p. 3).

Small community airports did experience some growth immediately following the ADA of 1978. Ironically, this growth was a result of the withdrawal of air service by the major airlines that operated jet service. Due to the small load factors often experience at small community airports, major airlines would be unable to earn a profit by utilizing more costly jet aircraft in these markets (GAO, 1996, p. 48). As previously mentioned, when the major airlines discontinued service to small community airports following deregulation, commuter airlines operating smaller, less costly turboprop aircraft filled the niche. During the period immediately following deregulation, regional airline market growth was experienced through code sharing between the smaller commuter airlines and the larger major airlines (Davies & Quastler, 1995). Thus, code sharing fostered an environment where the utilization of turboprop aircraft in the service of small communities became paramount.

The GAO (1996) reported that the view of the DOT, as voiced through interviews with analysts, was that the frequency of departing flights from an airport was the most important factor in the determination of an airport's quality of air service. The analysts also stated that the type of aircraft being utilized for service was the least most important factor in determining the quality of service. The basis for their view was that the overall size and safety of turboprop aircraft had increased dramatically since deregulation. DOT analysis, therefore, conducted a study showing that turboprop aircraft provide levels of service quality equivalent to that of jet aircraft. (GAO, 1996, pp. 48-49)

Unfortunately, passengers may not hold the same favorable feelings respective to turboprop aircraft as do the DOT analysts. One of the major determinants of the regional airline marketplace's focus was, and still is, passenger preference, which translates into market demand. As shown previously, passengers clearly prefer jet air service to turboprop air service. In a report by the OASAIA (1998) on Regional Jets, it was stated by one regional air carrier that due to the turboprop avoidance factor, passenger traffic would increase on some routes by as much as 20 percent if the turboprop aircraft servicing that route was replaced by regional jets. As a response to consumer preference, major airline' smaller code sharing affiliates are increasingly purchasing and utilizing jet aircraft (GAO, 1998, p. 11). As this purchasing phenomenon occurs, the quality of air service of small community airports by regional airlines, in the view of the GAO, will improve (GAO, 1998, p. 11).

## **5. The Insurgence of the Regional Jet**

In 1993, Comair began operating the Regional Jet and became the first domestic airline to operate an aircraft of this type. By 1996, Comair's operational and fiscal performances shattered all previous records. Revenues increased by 28 percent, earnings rose an unprecedented 105 percent and load factor increased to 54.1 percent. Comair attributed its part of its phenomenal growth to its decision to operate the Regional Jet. By 1997, having observed Comair's success, every major regional airline had Regional Jets on order (see Figure 2.1), with the top regional airlines possessing the intent on evolving into all jet fleets. (Prall, 1997, pp. 26-36)

Even though passenger acceptance of the Regional Jet has been as overwhelmingly high as their dislike of the turboprop, Boyd (1997) stated that these jets would not replace the turboprops on all operational routing. Leading industry experts agree that on routes with distances of greater than 400 miles that are being flown by turboprops, will see the infusion of Regional Jets (OASAIA, 1998, p. 2). Operational statistics have shown Regional Jets to have lower operating costs, compared to turboprop aircraft, on routes that are between 500 and 1,000 miles long (Morrow, 2000). The operational range of the Regional Jet, which in most cases at least doubles that of turboprops, has created new point to point, vice point to hub, connection opportunities which add to the customer appeal of the aircraft (Butler & Poole, 1998, p. 21). Butler and Poole suggested that the Regional Jet would allow many small communities, which lack nonstop jet service the opportunity to connect with others small cities also lacking jet service. However, on routes of 200 miles or less, the lower operating costs of the turboprop give it a distinctive advantage (Shifrin, 1997, p. 50). Another important reason why Regional Jets are unable to replace all turboprop operations are the small levels of ridership and the runway length limitations exhibited by numerous small community airports (Shifrin, 1997, p. 50).

While Regional Jets may not replace the turboprop in all operating regimes, Boyd (1997) concluded that they might dislodge many of them from the inventories of regional airlines. The higher purchase cost of the Regional Jet in comparison to those of turboprop and passenger distrust of the turboprop have lead to a reduction of turboprops from regional airline inventories (Morrow, 2000). In order to finance the purchasing of

Regional Jets, regional airlines are selling off their inventories of turboprop aircraft (Boyd, 1997). Also promoting the reduction of turboprop aircraft in regional airline inventories are passenger distrust and disdain of the turboprop. These factors have combined to become a catalyst propelling regional airlines to move toward all jet fleets (Pascual, 1997).

The future for the Regional Jet appears to be bright, while the forecasts for turboprops appears dreary (see Figure 2.2). In 1999, Bombardier's Canadair CRJ, a Regional Jet, replaced Saab's 340, a turboprop, as the regional airline market's leader in lift capacity, measured in passenger seats available, by supplying 14.12 percent of the industry's total lift capability (RAA, 2000). During 1999, Regional Jets provided for 31 percent of all regional lift (Jewell, 1999). During the next 20 years, industry experts predict that total Regional Jet sales will approach 2000 aircraft (Abbey & Bernstein, 1997).

In 1997, the FAA, in order to address safety concerns relating to smaller turboprop aircraft, began requiring air carriers to operate all aircraft designed to seat more than ten passengers, in accordance with regulations previously applied only to larger aircraft (Abbey & Bernstein, 1997). As a result, to avoid the costly upgrades, many regional airlines purged their 19 seat aircraft from their aircraft fleets, evidenced by a 11 percent reduction in utilization by regional airlines of aircraft seating 19 or fewer passengers (Jewell, 1999). Experts forecast that between 1998 and 2008, turboprop aircraft in this seating category will only make up seven percent of the total 1280 aircraft deliveries (Abbey & Bernstein, 1997). These were the main type of aircraft used by

regional airlines to service small community airports. Industry experts warn small communities that are anticipating the upgrading of their local airport's turboprop service to jet service, to not expect such deals if their airport's ridership or runway limitations prohibit such transitions (Shifrin, 1998, pp. 56-57). In fact, Boyd predicts that in the next ten years, over 100 small community airports will lose air service due to the regional airline market's acceptance of the Regional Jet.

#### **D. LEGISLATIVE AID FOR SMALL COMMUNITY AIRPORTS**

Poole and Butler (1998) revealed that constituents have besieged their policymakers with complaints regarding the quality and quantity of air service offered at many small community airports. Many of these policymakers lent an ear to their constituents and have introduced legislation that, if adopted, would brighten the future for the small community airport. The following are highlights from legislative aid for small communities that is currently being sought:

- *Air Transportation Improvement Act*: Legislation would increase Small Community Air Service grant program from 30 million dollars to 80 million dollars, would retain Airport Improvement Program eligibility for small airports where enplanements temporarily dip below 10,000, and would authorize grants to underserved communities for marketing incentive programs to attract and enhance air service (American Association of Airport Executives [AAAE], 1999).
- *Aviation Investment and Reform Act for the 21<sup>st</sup> Century*: Legislation would triple the minimum entitlement for non-hub airports from 500,000 to one point five million dollars, would create a loan guarantee program to assist airlines in buying Regional Jets if the airlines agree to use them to serve small community airports for 12 consecutive months, and would create a new

funding program to help small, underserved airports market and promote its air service (AAAE, 1999).

- *Small Communities Air Service Act of 1999*: Legislation would require the Secretary of Transportation to conduct a study into the efficacy of a program to provide federal loan guarantees for the purchase of Regional Jets by commuter air carriers and would establish a four-year pilot program to assist, through grants, up to 40 communities with inadequate access to the national transportation system in order to facilitate better air service linkups (AAAE, 1999).
- *Air Service Restoration Act*: Legislation would establish a five-year, 100 million dollar pilot aviation development program for up to 40 small and underserved communities with grants up to 500,000 dollars to each approved airport for local initiatives to attract and promote air service (AAAE, 1999).

#### **E. RESEARCH ISSUES**

A review of the relevant literature which spoke to the effects of the ADA of 1978 on the quality of air service offered at small community airports and the respective legislation enacted to counteract the resulting negative effects, and after a review of the relevant literature which spoke to the insurgence of the Regional Jet, the suggested results of this insurgence and the prospective legislation to improve the future of the small community airports, certain research issues were raised. In particular, no documented research was observed regarding the possible impact of the turboprop avoidance factor on the air service offered at small community airports.

With the recent insurgence of the Regional Jet into the regional airline marketplace, many passengers now have the option of choosing jet service as opposed to



with turboprop aircraft. It was shown that passengers would go to great lengths to avoid turboprop aircraft and utilize jet service, therefore, directly correlating turboprop avoidance with Regional Jet acceptance. This trend relates to small community airports because as documented by the GAO (1996), following the ADA of 1978, the predominant aircraft type utilized in the service of small community airports was the turboprop. Also, the OASIA (2000) listed that the type of aircraft most utilized to service EAS communities was the 19-seat turboprop, with 93 percent service utilization.

This thesis utilizes the concepts as discussed in the review of relevant literature, to quantify the effects of contemporary trends expressed in the regional airline marketplace. The EAS program eligibility requirements state limitations relative to how close an airport can be located, in highway miles, to a medium or large-hub community airport (Reynolds-Feigham, 1999, pp. 576-577). The Brewer and Thorson (1978) model utilized this principle of an airport's proximity to a major hub to capture the effects of a larger airport's attraction to passengers due to its superior quality of service, called the gravity effect, in comparison to a smaller community airport. This model, however, did not consider the contemporary concept of turboprop avoidance. Turboprop avoidance and the resulting market appeal of the Regional Jet have created an atmosphere where jet service has become available at much smaller airports. The DOT definition of a hub airport is one whose enplanements are 0.05 percent of the nation's annual total enplanements, which for 1997 was greater than 320,781 (Reynolds-Feigham, 2000, p. 559). Airports of this size are receiving jet service from major airlines (OAG, 1999). Therefore, the Brewer and Thorson model did not fully capture the results of the gravity

effect because it did not consider that there could be a higher quality of air service being offered at smaller airports, due to the insurgence of the Regional Jet.

The Hulet and Gordon (1982) model focused on frequency as the major determinant in predicting which small community airports should retain, or obtain, air service. Again, with the insurgence of the Regional Jet being prevalent in the last decade, this model did not determine what effect a small community airport's viability to jet service, had on its probability for maintaining air service.

Finally, the Vowles (1997) model, in predicting which small community airports would most likely lose air service, identified that communities that were receiving EAS subsidies definitely had a higher probability of losing air service. This conclusion was based on the concept that, due to the disruption of basic economic market realities caused by governmental subsidies, if a community were to fail to receive further subsidies, then it would lose its air service because of the lack of economically support. However, instead of using quantitative, historical data to determine whether or not a community would lose air service, the Vowles based its conclusion on human experience.

The focus of the research of this thesis is to determine, utilizing the quantitative methodology of variance analysis between relevant, historical and contemporary operational and spatial determinants, the effect of the Regional Jet on the quality of air service offered at small community airports.

**Table 2.1. Regional Passenger Traffic 1978-1998, From Jewell, 1999.**

<b>Year</b>	<b>Passengers Enplaned</b>
1978	11,026,000
1979	13,972,000
1980	14,810,000
1981	15,400,000
1982	18,550,000
1983	21,820,000
1984	26,140,000
1985	26,000,000
1986	28,360,000
1987	31,787,539
1988	35,188,223
1989	37,359,656
1990	42,099,429
1991	41,974,242
1992	48,893,195
1993	52,675,971
1994	57,120,423
1995	57,209,707
1996	61,949,594
1997	66,303,386
1998	71,103,706

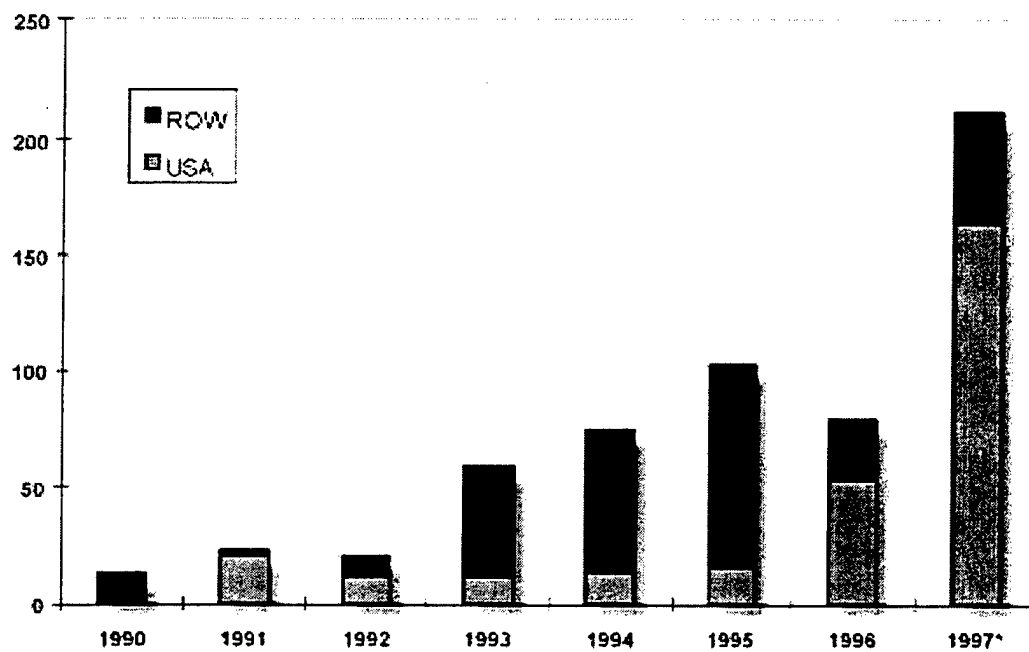


Figure 2.1. Regional Jet Orders By Region, From Abbey & Bernstein, 1997.

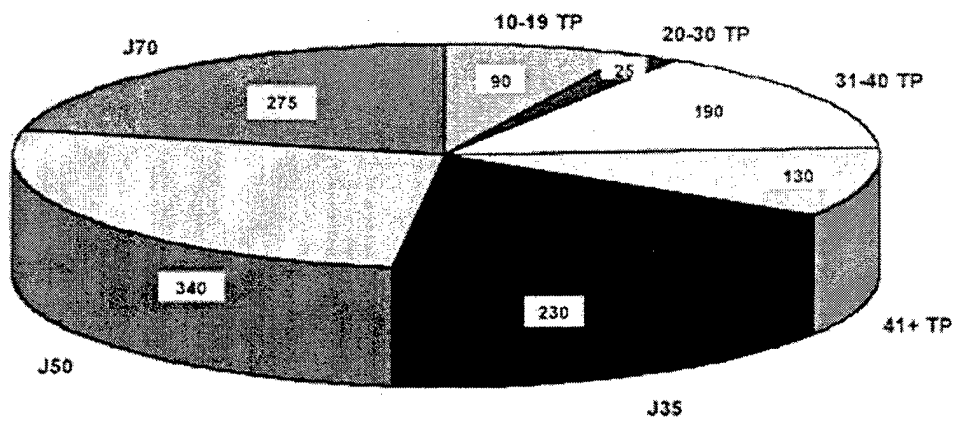


Figure 2.2. Regional Aircraft Deliveries Forecast for 1998-2008,  
From Abbey, D. & Bernstein, G., 1997.

Note: J=Jet, TP=Turboprop, & Associated Numbers Indicate Seating

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### **III. RESEARCH METHODOLOGY**

#### **A. RESEARCH FOCUS AND APPROACH**

##### **1. Research Focus**

In the absence of existing research relating to air service trends at small community airports, this thesis focuses on determining the impact, and the level of market influence, of the Regional Jet on the quality of commercial air service offered at small community airports. The determinants of air service quality utilized in this research were isolated to specifically include the frequency of flights being offered, the size and type of aircraft utilized for air service, the number of commercial passenger airlines servicing the airport, and the distance of that airport from an airport offering jet service. Two of these determinants, the size and type of aircraft utilized and the proximity of an airport to one offering jet service, specifically relate to the turboprop avoidance factor and/or the gravity effect, are direct results of the insurgence of the Regional Jet into the regional aviation marketplace. Flight frequency is an industry accepted determinant of the quality of air service rendered by any commercial airport.

##### **2. Research Approach**

In order to analyze the hypothesized significance of the determinants of quality on the level of air service being offered by small community airports, a variance analysis model was utilized. Variance analysis was used to identify the impact of certain operational and spatial variables on the determination of a small community airport's

level of passenger utilization. It was reasoned that if significant variance is found between the air service determinants of the differing airport groups, which were those that were identified as possibly retaining their air service and those that possibly would lose their air service, then assumptions could be made that identified the Regional Jet's effect on small community airports' levels of air service.

Small community airports that posted 1998 enplanements of 50,000 or less, were identified as those which had a possibility of losing their air service and therefore, were selected for possible analysis. This assumption was based on Boyd's (1998) determination that all airports with enplanements of or below 50,000, would be in jeopardy of losing their air service due to the insurgence of the Regional Jet. Of the commercial airports that had posted enplanements of 50,000 or less, only those being served exclusively by propeller propelled aircraft were selected for analysis. Therefore, the small community airports that were included in this study had the characteristics of posting 1998 enplanements of 50,000 or less and being served exclusively by propeller propelled aircraft.

To determine the different populations upon which to conduct a variance analysis, historical trend analysis was used on the selected small community airports, to determine whether or not a city had the probability of keeping (KEEP) or losing (LOSE) its air service. A (KEEP) designation was assigned to airports that had greater than 10,000 enplanements and a history of increasing or stable enplanements during the eight-year (1991-1998) observation period. Stability was determined as sustained performance, without the presence of dips in enplanements of 20 percent or greater than the airport's



eight-year enplanement average. A (LOSE) designation was assigned airports that posted 1998 enplanements of than 10,000 or a history of decreasing or unstable enplanement performance. The enplanement figure of 10,000 was used as a point of delineation, in conjunction with the FAA's separation of airports into two groups, primary and non-primary (see definitions on p. 9) (AAAE, 1999). Based on their classification as either a primary or a non-primary airport, airports receive different levels of governmental funding, due to their evaluated level of need. In essence, the FAA has determined that non-primary airports require additional funding because they possess a higher risk of losing their primary funding tool, which is their air service. The stability figure of 20 percent was used because it has been shown that Regional Jets can create market gains or possible losses, of 20 percent or more (Prall, p. 26, 1997). If an airport has been experiencing losses of 20 percent or more in its enplanement figures, it was assumed that the Regional Jet would greatly effect its demand for air service. Thus, through the use of Boyd's determination and the previously mentioned criteria, 79 airports were analyzed as those that would probably keep air service, KEEP designated, and 122 airports were analyzed as those that would probably lose air service LOSE designated.

## **B. MODEL VARIABLES**

- *DAY-ENPLANE*: This variable represents the average daily enplanement of an airport. This figure was calculated by taking the 1998 enplanement figures from the FAA's Air Carrier Activity Information System (ACAIS) and dividing that figure by 365 days.
- *AVL-SEATS*: This variable represents the number of available seats offered by an airport. It was determined by first, calculating the total number of seats available

on each of the airport's departing flights, and then, totaling these to identify the total number of departing seats available. The information for this variable was obtained from the OAG (1999). The variance between this variable's KEEP and LOSE components is expected to be relatively large, indicating that airports have been classified as those retaining their air service will be offering significantly more flights than those airports that were classified as probably losing their air service.

- *PLANE-SIZE*: This variable represents the maximum number of seats allowed on the largest type of aircraft being utilized to provide service to the airport. The information for this variable was obtained from the OAG (1999). The variance between this variable's KEEP and LOSE designated airports is expected to be significant, indicating that the airports identified as those which would retain their air service, are being serviced by larger aircraft. This will also be an expression of the dislike that passengers have relating to flying small turboprop aircraft, a variant of the turboprop avoidance factor.
- *AIRLINES*: This variable represents the total number of air carriers servicing the each airport. The information for this variable was obtained from the OAG (1999). The variance between this variable's KEEP and LOSE designated airports is expected to be relatively large, indicating that airports that will retain their air service are being serviced by more than one air carrier. The airports that will probably lose their air service are those being serviced by a sole air carrier.
- *ISOLATION*: This variable represents the highway distance from each small community airport to an airport that was listed in the OAG (1999) as having jet service. The variance between this variable's KEEP and LOSE designated airports is also expected to be significant, indicating that small community airports have a greater probability of retaining their air service, the further they are away from airports offering jet service. The closer a small community airport is to another airport which offers jet service, the more likely it is to lose it air service, because of the loss of passengers due to the gravity effect.

### **C. ANALYSIS COMPARISON**

A variance analysis was conducted between each variable's airports that were designated as those likely to keep their air service (KEEP) and those likely to lose their air service (LOSE). Through the comparison of these different groups of airports, conclusions were drawn relative to the differing levels of influence the Regional Jet had on the KEEP airports as opposed to the LOSE airports.

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## **IV. FINDINGS AND ANALYSIS**

### **A. FINDINGS OVERVIEW**

The data utilized for this study was taken from the historical, operational and spatial observations of 201 small community airports that met the inclusion criteria stated in Chapter III. Of the 201 airports, this thesis identified 79 small community airports that most likely are to retain their air service (KEEP) and 122 small community airports that most likely are to lose their air service (LOSE).

### **B. ANALYSIS**

To accomplish variance analysis within each variable, between the airports designated as KEEP and LOSE, the existence of significant variance between these different populations must be established. Table 4.1 summarizes the variance analysis statistics for each component of each variable.

#### **1. The Daily Enplanement Variable**

##### ***a. Analysis***

DAY-ENPLANE, a variable defining the average daily enplanement of each airport, was shown to have a large *F*-value and a small *P*-value. This signifies that the different populations of data, the KEEP and the LOSE components, exhibit significant variance and, therefore, are significantly different and distinct. The KEEP component of the DAY-ENPLANE variable, in comparison with its LOSE component,

Table 4.1. Summary of Variance Analysis Statistics

COMPONENT	N	MEAN	STDEV	F	P
<b><u>DAY-ENPLANE</u></b>				<b>30.87</b>	<b>0.001</b>
KEEP	79	53.25	26.59		
LOSE	122	30.02	30.38		
<b><u>AVL-SEATS</u></b>				<b>22.15</b>	<b>0.000</b>
KEEP	79	216.30	141.10		
LOSE	122	141.10	85.20		
<b><u>AIRLINES</u></b>				<b>10.86</b>	<b>0.001</b>
KEEP	79	1.32	0.57		
LOSE	122	1.11	0.34		
<b><u>PLANE-SIZE</u></b>				<b>10.94</b>	<b>0.001</b>
KEEP	79	25.86	8.59		
LOSE	122	22.05	7.53		
<b><u>ISOLATION</u></b>				<b>0.00</b>	<b>0.947</b>
KEEP	79	110.90	61.37		
LOSE	122	111.49	62.14		

had the higher mean, 53.25. Of the 201 small community airports observed, there were 35 airports identified within the KEEP component, 54 percent, which had DAY-ENPLANE values greater than its mean. Conversely, there were only 27 airports identified within the LOSE component, 22 percent, that had DAY-ENPLANE values greater than the larger KEEP mean of 53.25.

*b. Discussion*

The DAY-ENPLANE variable's components of KEEP and LOSE exhibited the most significant variance. This large variance between components was created by the significantly larger amount of daily enplanements posted by the airports identified within the KEEP component as compared to those within the LOSE component. An analysis of this data results in the logical conclusion that, the higher the amount of daily enplanements, the higher the probability that an airport will retain its air service.

DAY-ENPLANE is a direct result of passenger demand, because, by definition, it is an airport's passenger volume, and passenger volume is determined by passenger demand. The major determinant of demand that has been discussed by this thesis, has been turboprop avoidance, or rather, Regional Jet stimulation. Contemporary passenger demand has forced all of the major regional airlines to purchase Regional Jets to maintain their respective market shares. The higher a community's ridership, the more likely that community's air service is to be supplemented with jet service. The

communities that were studied in this thesis did not have the ridership necessary to support large jet aircraft. However, with many regional airlines experiencing breakeven load factors of as few as 21 passengers on their Regional Jets, certain small community airports may have the opportunity to receive jet service (OASAIA, 1998, p. 5). This will occur if an airport's daily passenger volume is at least 53 passengers, the mean of the airports identified as those most likely to retain their air service.

With passenger dislike and distrust of small, turboprop aircraft and their acceptance of the Regional Jet, demand for air service at small community airports with jet aircraft has been forecasted by industry experts to grow significantly in the next decade (Boyd, 1997). Therefore, though the significant variance found between DAY-ENPLANE's components of KEEP and LOSE was not created by the Regional Jet, the larger enplanement figures of those airports within KEEP, will become attractive marketplaces for Regional Jet operators. And with further market stimulation created by the entry of Regional Jets into these markets, the variance between those small community airports within KEEP and those within LOSE is forecasted to increase. Those airports within LOSE, who cannot spur enough market demand to maintain ridership to support Regional Jet service are predicted to lose their existing air service (Boyd, 1998).



## **2. The Total Available Seats Offered Variable**

### ***a. Analysis***

Observation of the variable AVL-SEATS, which represents the daily total number of seats available on all the airport's departing flights, exhibited a large *F*-value and a small *P*-value. These values indicate a significant variance between the KEEP and LOSE components of the AVL-SEATS variable, verifying that a comparison analysis between these two different populations of data can be performed. These differences in component populations are highlighted in the difference observed in the KEEP and LOSE mean values of 216.30 and 141.10, respectively. Within the AVL-SEATS variable, 52 of the airports identified within the KEEP component, 63 percent, offered greater than 150 daily seats available. However, 73 of the airports identified within the LOSE component, 60 percent, offered less than 150 daily seats available. If a market used a 50 seat Regional Jet to offer a minimum of three departures a day, a figure established as basic service in the EAS program, the minimum amount of seats offered by that market would be 150.

### ***b. Discussion***

The AVL-SEATS variable's components have the second most significant variance found in the model. This variable captures the combination of the determinants of frequency and aircraft size. In terms of frequency, as previously mentioned, the GAO (1996) reported the opinion of the DOT was that the frequency of departing flights was the most important factor in the determination of an airport's quality of air service. The GAO report also stated the type of aircraft servicing an airport was the least important

factor. Bombardier Aerospace (1998), airframe manufacturers of both turboprop and Regional Jet aircraft, had findings consistent with those of the GAO, stating that passengers indicated that flight frequency was the most important determination in their choosing flight service, while again, the type of aircraft providing the flight service was the least important factor.

The findings of this thesis concur with DOT's and Bombardier Aerospace's findings and opinions to the fact that flight frequency is an important determinant of demand. This thesis' findings illustrate this point in the variance analysis of the variable AVL-SEATS in Table 4.1. However, this thesis does not agree that the aircraft type is the least important factor of passenger demand. First, the statistics relating to the turboprop avoidance factor, which some Regional Jet operators have stated can be as much as a 20 percent improvement in market share, and with the phenomenal 1996 fiscal growth experienced by Comair, due largely to the replacement of its turboprop fleet with the Regional Jet, identify that aircraft type is a very important component of demand (Prall, 1997, pp. 26-28). Also included in the turboprop avoidance factor is the flying public's dislike and distrust of small turboprop aircraft. Frequency becomes inconsequential if passengers are not willing to fly on the aircraft. Second, also as previously mentioned, airlines are profit-seeking entities (Vowles, 1997, p. 827). Therefore, unless regulations or restrictions hinder them for doing so, airlines must match frequency and aircraft type and size with market demand in order to make a profit (Vowles). In essence, airlines will place a certain size and/or type aircraft into markets, to operate at specified frequencies, where passenger ridership will support them. This,

again, exhibits the importance of aircraft size and type as well as departure frequency, to flight demand.

To capture the importance of both frequency and, specifically, aircraft size in a single variable, the AVL-SEATS variable represents the number flight departures, frequency, multiplied by the number of seats from the aircraft offering those frequencies, aircraft size. Aircraft type was already built into the variable due to the fact that all the airports studied were receiving air service solely from turboprop or propeller driven aircraft. Thus, the large variance identified between the KEEP and LOSE components of AVL-SEATS, was a direct result of regional airlines matching the components of AVL-SEATS with market demand, expressed in ridership. Small community airports that were identified as those within the KEEP component had 52 airports, 63 percent, with AVL-SEATS values of greater than 150 seats, while airports identified as those within the LOSE component had 73 airports, 60 percent, with AVL-SEATS values of less than 150 seats. A commercial airport's future is only as viable as its air service. With the current market trends heavily favoring Regional Jet service, if an airport's flight demand cannot support Regional Jet service, then the future of that airport's air service is in jeopardy.

### **3. The Number of Airlines Variable**

#### ***a. Analysis***

The variable AIRLINES, which defined the number of commercial air carriers servicing an airport, exhibited a relatively large *F*-value and a small *P*-value. Again, these values indicate the existence of a significant variance between the KEEP and

LOSE components. Although the size of the F-value is not as large as found in the previously mentioned variables, there does exist a difference in the KEEP and LOSE components, as expressed in mean values of 1.32 and 1.11, respectively. These values indicate that of the airports studied the major portion of these received services from one airline. There were 21 airports within the KEEP component, 27 percent, which were served by more than one airline. There were only 12 airports within the LOSE component, 10 percent, that were served by more than one airline.

*b. Discussion*

The AIRLINE variable's components of KEEP and LOSE also exhibited significant variance. The relatively low enplanement figures of the airports included in this study, less than 50,000 during 1998, created a relatively small difference in variance between the AIRLINE components of KEEP and LOSE. Although there was a small separation of their mean values, a significant variance was shown between components due to the larger number of airlines that were servicing the KEEP component's airports, as compared to the LOSE component's airports. This is a logical conclusion because, according to basic economic principles, if more than one air carrier is servicing a community, then there should be enough ridership to support continued air service by at least one of the airlines, should one of the airlines discontinue service. The number of airlines serving a market also directly relates to the quality of air service offered in that market. Once again, since airlines are profit maximizing entities, if only one airline were to service a market, then air fares are expected to be higher than those offered in a market

with multiple air carriers where competition has limited air fares. All of these factors resulted in 21 airports, 27 percent, identified within the KEEP component being serviced by more than one airline and 110 airports, 90 percent, identified within the LOSE component, being serviced by a sole air carrier. Relating to the effect of the Regional Jet within this variable, currently there are less than 10 airports that receive jet service provided by a sole air carrier (OAG, 1999). Thus, airports with a sole carrier have a significantly lower chance of obtaining jet service. An analysis of these results leads one into the logical conclusion that, the more air carriers that service a market, the higher the probability that an airport will retain its air service.

#### **4. The Size of the Aircraft Variable**

##### ***a. Analysis***

An observation of the PLANE-SIZE variable, which represents the maximum number of seats offered on the largest aircraft servicing an airport, revealed a significantly large *F*-value and a small *P*-value, indicating the existence of a significant variance between the KEEP and LOSE components. The mean values of these components, 25.86 and 22.05, respectively, represent the average seating capacity of the aircraft utilized in service. Of airports within the KEEP component of the PLANE-SIZE variable, 42 received service from aircraft seating more than 20 seats, which represents 53 percent of its population. Of the airports within the LOSE component, 93 received service from aircraft seating 19 or fewer passengers, which represents 76 percent of its population.

*b. Discussion*

The PLANE-SIZE variable's components of KEEP and LOSE exhibited significant variance. Although their statistical means were separated by a small value, a significant variance was shown between components due to the larger number of aircraft with 20 or more seats that were servicing the KEEP component's airports, compared to those servicing the LOSE component's airports. The variance analysis results lead one to the conclusion that the larger the aircraft being utilized to serve an airport, the larger the probability that the airport will retain its air service. Relevant to this methodology is again, the airline's ability to match the size of the aircraft being utilized to the market's ridership demand. When airlines are unable to match aircraft size and market demand, such as is done under the aircraft a size limitation of the EAS program, they are certain to operate inefficiently and ultimately, will discontinue air service.

A direct connection can be identified between the variance analysis results and the turboprop avoidance factor. Passengers' dislike of small turboprop aircraft causes them to avoid flying. This avoidance leads to lower enplanement levels of airports solely dependent upon air service being provided by small turboprop aircraft with 19 or fewer seats. With the major regional airlines purging their aircraft fleets of all aircraft with 19 or fewer seats and with a bleak future relative to the future of other regional aircraft (see Figure 2.2.), airports being served solely by aircraft of this size, will have a very high probability of losing their air service. Interpretation of these factors resulted in 42 airports, 53 percent, identified within the KEEP component, being serviced by aircraft

with greater than 20 seats, while 93 airports, 76 percent, identified within the LOSE component, were being serviced by aircraft with 19 or fewer seats. Within the EAS program, aircraft seating 19 or fewer passengers, service 63 of EAS-subsidized communities' airports, which is 93 percent of all of EAS airports. This fact renders the majority of the EAS communities in jeopardy of losing air service should subsidies cease. In essence, the larger the aircraft utilized to serve a community airport, the higher the probability that the airport will retain its air service. Also, the larger the aircraft utilized to serve a community airport, the higher the probability that Regional Jet service will be substituted for its turboprop service.

## **5. The Isolation, Distance from Jet Service, Variable**

### ***a. Analysis***

The variable ISOLATION, which represents the distance each of the studied airports were from an alternative airport which offered jet service, exhibited a negligibly low *F*-value and a very large *P*-value, indicating little or no variance between its KEEP and LOSE populations. The lack of significant variance indicates that there is little or no difference recognized between the two populations, an observation highlighted by relatively equal mean values of 110.90 and 111.49. Thus, due to the lack of significant variance, variance analysis cannot be performed on this variable.

*b. Discussion*

The ISOLATION variable's components of KEEP and LOSE did not exhibit any significant variance, an indication that there exists little or no variation between these component populations. This fact is highlighted in the relatively equal mean values of 110.90 and 111.49, respectively, calculated for the KEEP and LOSES components. Although the lack of variation inhibits variance analysis, an analysis can be made based upon operational and market trends within the regional airline industry. The contemporary prominence of the Regional Jet has improved small communities' access to the national transportation system. This improvement has not been necessarily seen in industry wide increases in passenger traffic for small community airports, but rather in the decrease in distances passengers have to travel to reach an airport that provides jet service.

As the larger, small community and small-hub airports begin to receive jet service, traveling distances will decrease because passengers will utilize these airports as opposed to driving the extra distances often necessary to utilize services offered at the large or medium-hub airports. The average separation between the small community airports included in this study and airports serviced by Regional Jets was 111 miles. The significance of this fact can also be shown within the EAS program. During 1990, the average distance between the nearest large or medium-hubs was 171 miles for the subsidized communities (Reynolds-Feigham, 1999, p. 571). Comparatively speaking, the EAS communities observed in our study exhibited an average distance of 142 miles,



between the respective airport and the nearest airport offering jet service. Understanding that highway travel times will be dependent upon road quality and traffic conditions, however, all things being equal, the mean values observed within the ISOLATION variable place the majority of the small communities of this study, within a two hour and fifteen minute drive of Regional Jet service. With passengers willing to drive two to five hours to avoid turboprop service, one can deduce that when small community airports are this close to Regional Jet service, if they do not provide service that is at least equal to that of the alternative airport, then they will most likely will experience the "gravity effect." Thus, although variance analysis was not utilized, it was deduced that due to the expansion of affordable jet service as provided by the Regional Jet, more communities are located within a relatively close proximity of jet service. Therefore, relative to their respective airports, if the service is not comparable to that as offered by the Regional Jet, the local airports will most likely experience the gravity effect.

#### **6. Communities Most Effected by the Regional Jet**

Upon considering the cumulative results of the variance analysis calculations, relative to the variables defining the number of daily enplanements, available seats, number of airlines and plane size, all of which were shown to play major roles in determining an airport's flight demand, it was determined that the 34 airports identified in Table 4.2 are those most likely to lose service within the next decade. By determining the turboprop avoidance factor's or the Regional Jet stimulation's effect on each of

determinant variables, it was determined that the insurgence of the Regional Jet is the predominant reason why these airports are likely to lose air service.

Table 4.2. List of Cities Most Likely to Lose Air Service

CITY	STATE	CITY	STATE
Kinston	NC	Hot Springs	AR
Groton-New London	CT	Terre Haute	IN
Utica	NY	Clovis	NM
Bradford	PA	Beckley	WV
Rocky Mount	NC	Ponca City	OK
Winston-Salem	NC	Kingman	AZ
Fort Huachuca Sierra	AZ	Brookings	SD
Topeka	KS	Bluefield	WV
Anacortes	WA	Enid	OK
Las Cruces	NM	Jonesboro	AR
Fort Leonard Wood	MO	El Dorado	AR
Mountain Home	AR	Harrison	AR
Watertown	NY	Ottumwa	IA
Augusta	ME	Mattoon	IL
Rutland	VT	Manistee	MI
Dickinson	ND	Chadron	NE
Hobbs	NM	Yankton	SD

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## **V. CONCLUSIONS AND RECOMMENDATIONS**

### **A. SUMMARY OF FINDINGS**

The flight demand determinants for small community airports, that were found to be most affected by the insurgence of the Regional Jet, were those that indicated an airport's average daily enplanement, total amount of seats offered on departing flights, number of airlines that provided service and seating size of the largest aircraft that provided service. The differences in these variables, between the KEEP group and the LOSE group are statistically significant. In essence, if an airport had fewer than five daily departing flights, offered on propeller propelled, 19-seat aircraft, and was being serviced by only one airline, then that airport will most likely lose its air service within the next ten years. These trends, which were shown to exist as a result of the insurgence of the Regional Jet, are the characteristics of the 34 airports listed in Table 4.2.

### **B. CONCLUSIONS**

Passengers clearly prefer flying jet aircraft vice turboprop aircraft and will go to great lengths to do so. The relatively low operating costs of Regional Jets, compared to larger jet transports, will afford many small community airports, which have significant ridership, the opportunity of having their air service provided by jet aircraft. The Regional Jet represents an advancement in technology that offers the regional airline passenger "seamless service" as they connect to the regional's larger counterpart. Seamless service refers to the ability of a passenger to transfer from a regional airline,

onto its larger counterpart, without any noticeable difference in the quality of service. Unfortunately, as shown in this thesis, small community airports that have modest levels of enplanements, currently receiving service by turboprop aircraft that seat 19 or fewer passengers and are within two and a half hours of an alternative airport that offers Regional Jet service, or any jet service, will find themselves in search of air service in the next decade. Of the 34 airports that were listed as most likely to lose air service due to the Regional Jet, all had the operational and spatial high-risk characteristics that were just listed. Two of the 34, Winston-Salem and Kinston, North Carolina, have already lost air service. In both cases, airport enplanement dropped significantly between 1996 and 1999, the period where Regional Jet utilization became prominent, because passengers chose to drive to nearby airports that offered jet service. Even though the airports were being serviced by 19 seat turboprop aircraft that provided just four departures a day, ridership still dropped below levels necessary for the servicing airline to just break even. Since 1991, these two small community airports experienced an average enplanement drop of 40 percent, due to market trends such as turboprop avoidance and the gravity effect (FAA, 1999). Unless situations or trends within the regional airline industry drastically change, the remaining 32 are apparently heading for the same fate.

In addition to the EAS program, there are four additional legislative packages that represent an attempt at resolving the small community airports' air service woes (see Legislative Aid to Small Community Airports in Chapter II). Though all require increased governmental funding directed toward small community airports, two of these packages propose to provide governmental backing of the purchase of Regional Jets by

regional airlines, for the specific purpose of providing service to small community airports. Governmental influences, as directed by regulations that limit the free movement of market forces, can create gross inefficiencies within the marketplace. Instead of re-regulating an industry whose deregulation has netted passengers an estimated annual savings of 19.4 million dollars, observers have suggested that all remaining governmental economic interventions should be removed (Butler & Poole, 1998, p. 1). An example of this can be found within the current administration of the EAS program. Over the past five years, passenger enplanements have only grown six-tenths of one percent, while per community and per passenger subsidies have increased 50.2 percent and 66.6 percent respectively, at EAS subsidized small community airports (GAO, 2000, p. 20). These figures show that empty seats on numerous 19-seat aircraft are being subsidized. Again, this is due to the fact that passengers just do not want to fly small turboprop aircraft, even if their seats are subsidized. Also, it should be noted that 19 out of the 34 communities, 56 percent, identified as those whose airports were predicted to lose air service within the next decade, were communities that are receiving EAS subsidies. This program's inefficiency mandates the necessity of a program revision and a rethinking of governmental, economically based intervention in the regional airline industry.

### **C. RECOMMENDATIONS AND POSSIBLE SOLUTIONS**

Market forces created the Regional Jet. Regional airlines wanted an aircraft that could approximate the range and speed of larger jet transports, but at operating costs

similar to large turboprop aircraft. They have also known for quite some time that passengers do not like flying on turboprop aircraft, but did so because they had no feasible alternative (Morrow, 2000). The Regional Jet was the manufacturers' supply answer to a market-driven demand issue.

Legislation that promotes the purchase of Regional Jets with government backed loans, that will funnel government funds into small community airports or that subsidize air service, does not allow the market the freedom to adjust to possible demand changes. Just as the Regional Jet was a response to market demand, so might some other aircraft fill the void left in regional air service due to current market trends. If passengers choose to drive to an alternate airport to fly Regional Jets, and enroute, pass their local, small community airport, then this should be allowed, without government intervention. This will cause many airports, especially those listed in Table 4.2, to lose their air service. When passengers decide that they want to fly out of their local, small community airports again, as opposed to driving several hours to find jet service, then the demand for local service will increase. Airlines seeking new markets, or possibly, newly formed ones seeking to fill the need, will begin to demand aircraft from aircraft manufacturers, that are suited to most efficiently and effectively fill the need, while meeting the quality demands of the passengers. Legislation impedes innovation and development because it fills a current need with current technology. If the need is allowed to persist without interference that is external to the market, then innovators will devise new and better ways of efficiently addressing current needs with futuristic solutions. In other words, if small community airports are allowed to lose service and they do so at such an alarming



rate that customers are hindered in carrying out their desire to travel, then demand will rise to a level that will promote the development of new airlines and new aircraft to supply the market's demand.

EAS funding should be reduced by granting subsidies to only those select few airports whose communities are remotely located and whose surface connections to other major metropolitan areas have been evaluated as poor. In cases such as these, air service is not a luxury, but a necessity. Funding agencies should keep in mind that the goal of the EAS program is to ensure small communities have access to the national transportation system. Access does not necessitate air service, but could also be achieved via highways or railroads. Government funding of small community airports in order to promote air service should be reconsidered. Communities who derive their own solutions to their air service problems, are much more likely to support the resulting outcomes. A popular example of this is the uniting of a community's business entities to form partnerships with local airports and air carriers in an effort to promote air service. Community support, in cases such as these, has been known to be relatively high, which renders positive results to all associated parties.

One possible resolution to the small communities' air service problem is regionalization. Regionalization involves small communities joining together and supporting one airport in their region, with their ridership. The combination of several small community airports ridership could possibly heighten that regional airport's enplanements to a level that would attract and support Regional Jet service. The reluctance to do this is high, as most communities are not willing to voluntarily surrender

their air service. However, with the lack of growth exhibited by small community airports due to current market trends such as the turboprop avoidance factor, may force communities into action. For small communities whose airports are not reasonably located with other small community airports, improving the highway systems, vice regionalization, is a more viable resolution.

#### **D. RESPONSES TO RESEARCH QUESTIONS**

Simply put, Regional Jets have decreased, and will continue to decrease, the quality of air service offered at small community airports. Only those airports with enplanements sufficient of supporting Regional Jet service stand to benefit from its insurgence into the regional airline marketplace. Government agencies should not rush to fund solutions to the air service problems of the small community airports, but rather, foster an atmosphere where communities are empowered to formulate their own solutions. This is due to the positive possibilities of community focused, vice government focused resolutions and because governmental economic intervention into the marketplace can create numerous market inefficiencies. The withdrawal of governmental intervention is not new, for it was the focus of the Airline Deregulation Act of 1978. Ironically, because of governmental concern relative to the loss of air service by small community airports as a result of the ADA of 1978, EAS legislation was enacted to protect these airports and to ensure that they remain connected to the national transportation system. Thus, the ADA of 1978 had the same effect on air service to small

communities, as does the contemporary acceptance of the Regional Jet, which is they both created a reduction in the quality of air service offered by small community airports.

#### **E. SUGGESTED FURTHER STUDIES**

To examine the full effect of the Regional Jet on the commercial aviation marketplace, possible future studies could be focused on the following:

- The Regional Jet's effect on the EAS program, dealing specifically with the viability of subsidies and current eligibility requirements.
- The turboprop avoidance factor's effect on the future development turboprop technology.
- Possible alternatives to aviation subsidy programs.

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